

Mode of Ecological Civilization Construction Based on Water Environment—Case Study of Hefei City and Chaohu Lake Basin

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Abstract: Excellent practices and experiences in industrial development, resource conservation, environmental governance, ecological protection, and watershed management mechanism are introduced from the urban (e.g., Hefei City in Anhui Province) and river basin (e.g., Chaohu Lake Basin) levels. A “three-water improvement” model for ecological civilization construction in urban and rural areas in Hefei, and a “three-ecological optimization” model for ecological civilization construction in Chaohu Basin are summarized through surveys. Meanwhile, development suggestions are proposed to solve problems existing in water ecological environment construction in Anhui Province, including promoting green economic development, strengthening environmental governance and ecological restoration, establishing a dynamic monitoring and early-warning mechanism, improving the watershed management mechanism, and establishing an ecological compensation mechanism and a marketization mechanism.

Keywords: ecological civilization; water environment; watershed collaboration; key measures

1 Introduction

On May 18, 2018, at the National Conference on ecological environment protection, general secretary Xi Jinping pointed out that “we should intensify efforts to promote the construction of ecological civilization, solve ecological and environmental problems, resolutely fight the battle of pollution prevention and control, and promote China’s construction of ecological civilization to a new level.” As a key part of ecological protection, the water environment is a core factor of ecological civilization construction [1,2]. Ecological civilization construction promotes the transformation of production, consumption, and living patterns, and promotes the formation of cross basin governance mechanisms, marketization mechanisms, and green financial systems, which have become a fundamental guarantee for long-term water control.

The shortage of water resources, pollution of the water environment, and destruction of water ecology are serious in China. Therefore, the construction of ecological civilization based on the water environment is vital [3]. River basin governance in China involves multiple administrative regions; however, the regional coordination mechanism is incomplete, which is not conducive to the further advancement of ecological civilization construction [4]. Worldwide, countries and regions, such as the United States and European Union, have established inter-governmental watershed governance models. An increasing number of regions have significantly advanced concerning the problem of watershed governance, by improving the consultation mechanism and making the public, social organizations, and other stakeholders extensively participate during consultation [5].

Anhui Province has developed water systems, along with numerous rivers and lakes. During the processes

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involved with economic/social development and ecological civilization construction, much work (with water as the main focus) has been done concerning resource protection, environmental governance, and ecological restoration. Ecological civilization construction based on water has become important in Anhui Province, which has created practical experiences that can be replicated and promoted. Based on the practice of ecological civilization construction on the water environment, this study takes a city (Hefei) and watershed (Chaohu Basin) as examples to explore methods that can be promoted and help more regions to improve the level of ecological civilization construction.

2 “Three-water improvement” model for ecological civilization construction in Hefei

2.1 Mode for ecological civilization construction

According to system engineering, we should implement the key tasks of ecological civilization construction, effectively guarantee energy and resources, control environmental pollution, and improve the ecological environment to create better production and living environments for society. Hefei City uses the links between the water resources, water environment, and water ecology to promote ecological civilization construction, which has formed the “three-water improvement” model.

2.1.1 Improving the utilization efficiency of the main resources by focusing water resources

With the acceleration of China’s industrialization and urbanization, the demand for resources and energy is increasing, and the economic and social problems caused by resource shortages are becoming unmistakable. By focusing on water resources, Hefei City comprehensively promotes the conservation and recycling of major resources, significantly reduces the intensity of resource and energy consumption, improves the efficiency of resource and energy utilization, and alleviates the constraints of resources and the environment:

(1) Improve the allocation and utilization of water resources

To do this, the strictest control over water resources must be imposed. Hefei adjusted the agricultural planting structure and carried out water-saving transformations in the irrigation area, so that the utilization efficiency of the agricultural irrigation water was continuously improving. By promoting industrial transformation and advanced water-saving technology/equipment, the reuse rate of industrial water increased to 90%. The domestic water use efficiency was improved comprehensively by adopting a stepped water price system, promoting water-saving appliances, and encouraging water supply network reconstruction. In addition, Hefei achieved the multi-channel supply and multi-level utilization of water resources by accelerating wastewater reutilization, promoting the utilization of rainwater resources, and promoting the use of reclaimed water for landscape water supply, industrial cooling, domestic miscellaneous water, and city greening, etc.

(2) Optimize the energy supply structure and utilization efficiency

First, the energy structure must be adjusted. In combination with new urbanization construction, Hefei expanded the scope of “coal-free zones,” by strictly controlling the total amount of energy consumption especially the excessive growth of total coal consumption, to increase the proportion of electricity, natural gas, and renewable energy consumption in areas including residents’ lives, industry, and transportation. Additionally, Hefei built a diversified energy supply pattern. Second, Hefei accelerated energy-saving technical transformations in key industries through a series of measures, such as accelerating industrial transformation, eliminating backward production capacity, and promoting energy efficiency benchmarking. Third, Hefei promoted green building, increased the proportion of public transportation, and guided the public to low-carbon travel, therefore improving energy conservation in key areas, such as construction and transportation.

(3) Improve the utilization of solid waste

In the field of bulk solid waste, Hefei focused on promoting the comprehensive utilization of industrial solid waste, such as metallurgical slag, chemical slag, and phosphogypsum, as well as agricultural waste, such as crop straw, large-scale livestock waste, and poultry waste to further improve the utilization efficiency. In addition, Hefei enhanced the level of classified collection and reuse of renewable resources, while promoting the segregation of waste during collection and transportation, centralization of waste collection, detoxification, and co-processing of major waste types, such as municipal solid waste, kitchen waste, and construction waste. This was done to improve the resource utilization efficiency and reduce the pollution of water bodies and soil.

2.1.2 Controlling environmental pollution by taking water environment as a breakthrough

Environmental protection is a major social issue, which is related to people’s livelihoods. With the continuous

improvement of people's living standards, the requirements for a beautiful environment, such as blue skies, white clouds, green hills, and clear waters, are increasing. In the construction of ecological civilization, we must face realistic demands, seek solutions to emerging environmental challenges, such as water pollution, promote the continuous improvement of environmental quality, and increase the provision of high-quality ecological products to meet the growing needs of the people.

(1) Improve the capacity of water pollution control

Hefei City made overall plans to promote the construction of sewage treatment facilities, constantly improved the sewage treatment capacity of towns and rural areas, and therefore accomplished the full coverage of sewage treatment facilities. The effluent index of the new sewage treatment plants strictly implemented the requirements of the *Discharge Limits Of Major Water Pollutants for Municipal Wastewater Treatment Plants & Industries in the Chaohu Basin (DB34/2710—2016)*, and the effluent standard has reached the highest level in China. In combination with the reconstruction and expansion of existing sewage treatment facilities, Hefei also implemented standards to improve the effluent quality and decrease the input of nitrogen and phosphorus pollution into the Chaohu Lake. Hefei also accelerated the extension and improvement of the pipe networks of the sewage treatment plants around Chaohu Lake, and promoted the transformation of pipe networks for the separate collection of rainwater and sewage pipes, so that the sewage can be effectively collected/treated and flooding is essentially eradicated.

(2) Promote the treatment of rural garbage and agricultural non-point source pollution

The random discard and storage of rural domestic waste and agricultural non-point source pollution is the main factor that causes water pollution. For rural domestic waste, Hefei promoted a rural domestic waste management mode with "village collection, township transfer, and city and county treatment" as the main pattern for managing domestic waste. The collection, transportation, and treatment capacity of rural domestic waste was constantly improved by the layout planning of transfer stations and construction of terminal treatment facilities. In 2017, Hefei launched waste classification pilot projects in 29 towns and 59 villages, effectively achieving waste reduction and recycling.

For livestock and poultry pollution, Hefei promoted the closure or relocation of farms in prohibited areas and established a normalized regulatory mechanism to prevent "resurgence." Hefei also carried out investigations on large-scale livestock and poultry farms with no supporting facilities for manure treatment, and promoted the construction of facilities for collecting, storing, transferring, and composting of solid manure. All the new large-scale livestock and poultry farms were equipped with supporting facilities to improve the treatment and resource utilization efficiency of manure.

2.1.3 Promote the optimization of urban and rural ecosystems using water ecology as the link

Water is one of the core factors within ecological civilization construction. At present, the over-exploitation of water resources has caused a series of problems, such as river cessation, rivers and lakes drying up, and wetland shrinkage in some areas. During the construction of ecological civilization, we must adhere to the harmony between humans and nature, systematically carry out the protection and restoration of ecological elements, such as mountains, rivers, forests, fields, lakes, and grass systems, and promote the virtuous cycles of the ecosystem.

(1) Water ecosystem protection

Water ecosystem protection is an important part of ecological civilization construction. As the national pilot city for water ecosystem protection, restoration, and ecological civilization construction, Hefei accelerated the ecological protection and restoration of the Chaohu Lake area using engineering projects, such as water resource allocation, flood control, pollution control, and ecological water supplement. Therefore, the construction of water ecological civilization has been organically incorporated into the overall process of urban transformation, which established the "coexistence of cities and lakes and the harmony between people and water" development model.

(2) Ecological restoration of forests and wetlands

Landscapes, forests, farmlands, lakes, and grasslands are all a part of the community and require consideration. Hefei always adheres to the priority of ecological restoration. Through taking measures, such as the reforestation of farmlands, configuring plant communities scientifically, and restoring ecological wetlands, Hefei promoted the construction of a National Forest Park, which is the first created by the artificial reforestation of farmland through ecological restoration. Hefei accelerated the construction of sewage purification and urban wetlands, and the restoration of rural wetlands, such as ditches, ponds, and farmlands, to purify and reduce the non-point source pollution entering the lake. The ecological restoration of forests and wetlands has played an important role in improving the urban climate, enhancing water quality, conserving water resources, and improving the ecological protection and restoration of Chaohu Lake.

2.2 Comprehensive evaluation of the Hefei case study

Taking the *Evaluation Target System of Ecological Civilization Construction* and *Green Development Index System* as references, and based on the actual construction situation and development needs of Hefei City, 4 categories and 17 indexes were selected to build the evaluation index system under the “three-water improvement” development mode in Hefei City (Table 1).

Table 1. Evaluation index system of the “three-water improvement” ecological civilization development in Hefei City.

Category	Index	Units	2010	2015	2020
Resource utilization	Water consumption per ten thousand yuan GDP	m ³ /10 ⁴ Yuan	80.9	53.8	41.4
	Energy consumption per unit of GDP	tce/10 ⁴ Yuan	0.495	0.372	0.309
	Proportion of non-fossil energy in primary energy consumption	%	4.0	6.0	8.0
	Comprehensive utilization rate of general industrial solid waste	%	85.0	91.7	95.0
	Comprehensive utilization rate of crop straw	%	75.0	85.0	90.0
Pollution control	Emission reduction of chemical oxygen demand	×10 ⁴ t (5 years accumulation)	—	3.30	1.85
	Emission reduction of ammonia nitrogen	×10 ⁴ t (5 years accumulation)	—	0.50	0.24
	Emission reduction of sulfur dioxide	×10 ⁴ t (5 years accumulation)	—	0.60	0.46
	Emission reduction of nitrogen oxide	×10 ⁴ t (5 years accumulation)	—	0.90	0.88
	Annual average concentration of fine particles (PM _{2.5})	μg·m ⁻³	—	66.0	53.0
Ecological environment	Water quality standard rate of the water function area	%	50.0	57.0	65.0
	Forest coverage rate	%	11.6	26.8	28.0
	New wetland area	×10 ⁴ hm ² (5 years accumulation)	—	0.28	0.30
Green life	Popularization rate of water-saving appliances in the main urban area	%	90.0	99.0	100.0
	Proportion of urban hydrophilic shoreline	%	50.0	74.0	80.0
	Residents’ awareness of ecological civilization	%	75.0	85.0	90.0

Note: The data sources of the index system include *The 13th Five Year Plan of National Economic and Social Development of Hefei City*, *Comprehensive Work Plan of Energy Conservation and Emission Reduction During the 13th Five-Year Plan of Hefei City*, *Pilot Implementation Plan of Water Ecological Civilization Construction of Hefei City*, and *Information Announcement on Prevention and Control of Solid Waste Pollution of Hefei City*.

Under the “three-water improvement” mode, water and energy consumption have been decreasing yearly, the resource utilization efficiency has been gradually improving, and the centralized sewage treatment rate in the main urban area has reached over 95%. In addition, the water quality of Chaohu Lake has been improving gradually, the environmental quality has been significantly improved, the ecological wetland area of Chaohu Lake has reached 37.78 km², and the ecological system has been continuously optimized.

Based on the evaluation index system, this study makes a monetization evaluation of the benefits generated by the three major measures, i.e., improving the efficiency of resource and energy utilization, environmental pollution control, and ecosystem protection/restoration. Among them, the benefits of resource conservation mainly include water saving, energy saving, and utilization of renewable resources. The pollution emission reduction mainly includes the chemical oxygen demand, ammonia nitrogen, sulfur dioxide, and nitrogen oxide. The ecological quality improvement mainly includes new forest and wetland areas. The calculation shows that in 2015 and 2020, the comprehensive benefits of “three-water improvement” model in Hefei were 65.6 and 148.7 billion yuan, respectively. The construction of ecological civilization with the water resources, water environment and water ecology as the main focus has promoted significant benefits (Table 2).

Table 2. Comprehensive benefits of the “three-water improvement” development mode in Hefei City (100 million yuan/year).

Year	Benefits of resource conservation	Benefits of pollution emission reduction	Benefits of ecological improvement	Total
2015	629	0.30	26.7	656
2020	1484	0.17	2.7	1487

Note: The benefits of pollution emission reduction mainly refer to the cost saving of pollution reduction, and the benefits of ecological environment improvement caused by pollutant reduction is temporarily not considered.

3 “Three-ecological optimization” model for ecological civilization construction in the Chaohu Basin

3.1 Ecological civilization construction model in a river basin

We will firmly insist on following a development pattern focusing on production, affluent life, and sound ecological civilization as the objectives in building a beautiful China. On the basis of the resource carrying capacity and with the improvement of water quality as a tight constraint, the Chaohu Lake Basin Management Department synchronously optimized the industrial and social development of each city in the basin, and promoted cross-regional cooperation. This promotion has led to the development of the “three-ecological optimization” model, which involves production development under ecological constraints, urban planning under ecological constraints, and ecological cooperation.

3.1.1 Production development under ecological constraints promotes industrial transformation

Industrial development is the main driving force for the rapid development of the national economy, and is also the main source of environmental pollution. Industrial structure adjustment, optimization, and upgrading are important measures to reduce pollution. With the water quality improvement as the main focus, Chaohu Lake Basin Management Department strengthened the red line control, reasonably guided industrial development, and accelerated industrial transformation, which has caused the constant improvements in regional green development.

(1) Strengthen red line control

The water environment of Chaohu Basin was demarcated into first-, second-, and third-level protected areas [6]. Chaohu Basin Management Department implemented the planning and control of industrial and project layouts, and strictly followed three red lines: ecological function guarantee baseline, environmental quality and safety baseline, and natural resources utilization line. Chaohu Basin Management Department also made a negative list on industry access, strictly enforced environmental access standards, and strictly controlled the growth of industries.

(2) Accelerate industrial transformation by optimizing the existing industries

First, green and new industrial developments need to be promoted. Chaohu Basin Management Department cultivated strategic emerging industries, and encouraged/supported the transformation of traditional manufacturing industries, such as household electric appliances, automobiles, engineering machinery, building materials, and new chemical industries, to move towards high value-added and high-tech industries. Second, the development quality of modern service industries in the river basin need to be improved. Relying on the characteristic ecological resources of Chaohu Lake, Hefei cooperated with other cities in the watershed, such as Ma’anshan, Wuhu, and Liu’an, to promote the development of tourism, cultural creativity, and other related industries. According to the development basis and characteristics of each city, they cultivated and expanded service formats, such as finance, modern logistics, and trade. Third, Chaohu Basin formed a modern ecological agricultural system by relying on key projects, such as food production upgrading, high-efficiency facility agricultural expansion, agricultural product processing and upgrading, and ecological agriculture acceleration.

3.1.2 Urban planning under ecological constraints optimizes ecological patterns

With rapid urban and economic development, high-intensity economic and social activities have led to the gradual deterioration of the ecological environment, with particularly adverse effects on the water environment that are closely related to production and daily life, which threatens the sustainable development of the regional environment. Chaohu Lake Basin Management Department carefully controlled the scale of urban development, strengthened the supporting facilities for pollution control, improved the river basin management mechanism, promoted the coordinated development between the city and water environment, and finally established the urban development mode, which was conducive to improving the water environment.

(1) Optimize the development scale and spatial layout of towns

First, the spatial pattern and division of the ecological functions of the river basin need to be defined. The Chaohu Basin was divided into three ecological areas: control (prohibited construction area), conservation (restricted construction area), and coordination (suitable construction area) [7]. Chaohu Basin Management Department strengthened the constraints on the ecological environment, set up the shorelines, rivers, regions, and industries whose development were prohibited, and implemented stricter management requirements. Second, Chaohu Basin Management Department insisted on the “Co-existence of cities and lakes” and scientifically determined the scale of urban development based on the environmental carrying capacity. Chaohu Basin Management Department reasonably controlled the population and scale of construction land, delimited the urban development boundary, strictly controlled the use of new land for construction purposes, increased the efficient use of stock land, rationally developed and utilized urban underground space resources, and comprehensively improved the permeability and micro-circulation capacity of cities.

(2) Improve the construction of pollution disposal facilities

To improve the capacity of water pollution control, the exiting sewage treatment facilities in cities and towns of Chaohu Basin were upgraded to improve the discharge standards of major pollutants. The sewage treatment facilities of the Nanfei, Shilihe, and Paihe Rivers were transformed in accordance with the Class A standards. The combined sewer system was also transformed. Chaohu Basin promoted decentralized sewage treatment technology, built high-standard sewage treatment facilities, and supported pipe networks to improve the centralized sewage treatment rate.

To strengthen the comprehensive improvement of the environment, Chaohu Basin Management Department classified municipal domestic waste and gradually established a network of garbage collection and treatment facilities throughout the river basin to promote the detoxification, reduction, and resource utilization of domestic garbage treatment. Then, Chaohu Basin Management Department improved the pollutant treatment facilities in rural areas, established a number of waste transfer stations and treatment facilities, and achieved the utilization of organic waste in rural production and living. Simultaneously, Chaohu Basin Management Department developed green and ecological breeding, strengthened the control of non-point source pollution, and reduced the pollution load into the lake.

3.1.3 Ecological cooperation: rationalizing the long-term mechanism behind river basin management

The governance of Chaohu Basin involves many regions and departments. In the management process, there is a lack of an effective regional coordination mechanism, which is an urgent issue.

(1) Improve the comprehensive management system

First, the legislative and execution systems for the protection of Chaohu Lake were explored. The legislation of the *Chaohu Lake Basin Management Regulations* was promoted and the *Chaohu Lake Basin Water Pollution Prevention Regulations* was revised and strictly implemented to strengthen the legal guarantee of Chaohu Lake Basin governance. Second, the cross-regional linkage mechanism was improved. Chaohu Basin involves many administrative regions, and regional cooperation is the key to comprehensive watershed management. Chaohu Basin has realized unified planning, management, and protection by the construction of an efficient administrative organization. Interconnected cross-administrative working mechanisms was also established to jointly verify the water pollution capacity, strictly control the approval of sewage discharge outlets to rivers, strengthen the control over the total amount of pollutants discharged into rivers, strengthen the monitoring and management of water quality in river basins, and ensure the achievement of water quality monitoring targets set by the state. Third, the supervision channels need to be broadened. Chaohu Basin Management Department issued documents such as the interim measures for supervision and management of the construction of ecological civilization pilot demonstration zones in the Chaohu River Basin and interim measures for management responsibility investigation, and intensified the investigation and punishment of violations.

(2) Carry out pilot work concerning the ecological compensation mechanism

Ecological compensation mechanism for the comprehensive improvement of the water environment was explored to promote ecological compensation between the upstream and downstream areas of the river basin. Chaohu Basin carried out pilot work on ecological compensation, reasonably determined the ecological compensation indicators and control objectives by taking the amount of major pollution as the main means, and set the compensation coefficient according to the completion degree of the control objectives. An ecological compensation pilot was carried out in Tongyang River Basin to explore the ecological compensation method across administrative boundaries. In the pilot, 5 ecological compensation indexes, including chemical oxygen demand, ammonia nitrogen, total nitrogen, total phosphorus, and water entering into the lake, were determined, and the ecological compensation

funds were undertaken by Hefei City, Chaohu City, and Tongyang Town in the proportion of 5:3:2.

3.2 Comprehensive evaluation of ecological civilization construction in Chaohu Basin

Through advancements in the production development and urban planning under ecological constraints and ecological cooperation, Chaohu Lake Basin has achieved the sustainable development of industrial structure transformation, rational and orderly urban development, and steady progress concerning ecological protection and restoration. In 2018, the per capita GDP in Chaohu Basin reached 70 000 yuan. The proportion of the three industries was adjusted to 2:53:45. The forest cover rate has reached 30%, and the restoration area of ecological wetland around Chaohu Lake was approximately 2500 hm². Based on the “three-ecological optimization” mode, a monetization evaluation was performed on the benefits from two aspects: basin industrial upgrading and resources/ environment. Among them, the benefits of industrial upgrading refer to industrial transformation and increased values of products brought by the ecological civilization construction. The benefits of urban and rural resources and environments include water resource conservation, energy conservation, and ecological improvement. The evaluation results show that under the “Three-ecological optimization” development mode, the monetization value of the main comprehensive benefits in 2018 was approximately 85.7 billion yuan. Chaohu Basin has accomplished a transformation from ecological advantages to economic and social benefits.

By coordinating the relationship between economic development and environmental protection, Chaohu Basin promoted green, low-carbon, and cycle development, achieving the simultaneous improvement of economic, social, and ecological benefits, and explored the high-quality development path of transforming green water and mountains into gold and silver mountains.

4 Suggestions for the development of ecological civilization based on the water environment

In recent years, the pollution control of Hefei and Chaohu Basin has progressed, however, it is still far from the national requirements. The governance of Chaohu Basin is facing the following problems. First, there is still a problem concerning the periodic variation in the water quality. In the first half of 2018, the water quality in Chaohu Lake was generally Grade IV, which is slightly polluted, and the water environment situation was severe. Second, there is still a contradiction between economic/social development and water environment management in Hefei and Chaohu Basin. In the objective management assessment of Anhui, the objectives still focused on economic development, which lead to the lax implementation of pollution prevention/control and the continuation of wetland destruction and encroachment on lake surfaces. Third, water pollution treatment in Chaohu Basin faces practical problems, such as the difficulties concerning cross-regional cooperation and the large number of stakeholders involved. Due to the overlapping functions and unclear responsibilities of the river basin management agencies, the system does not work effectively.

From the ecological civilization construction in Hefei City and Chaohu Lake Basin, the current challenges were systematically analyzed in this study, and five suggestions were put forward for similar provinces or regions in China.

4.1 Implement green development and transform the economic development pattern

The implementation of green development is the fundamental solution to the problem of pollution. Areas with water environments should establish green development, deal with the relationships within the coordinated protection of the water ecology, economic development, and social development, and form the internal impetus of resource conservation and environmental protection to promote high-quality economic development. First, persist on “deciding production by water,” promote the transformation of industrial structure, formulate a negative list of industrial access, comprehensively promote cleaner production, strengthen the prevention and control of pollution, and promote greener development with low-input, -consumption, and -emissions. Second, persist on “deciding city by water.” Taking the environmental carrying capacity as a limitation, strictly define three control lines within the basin, i.e., ecological redline, permanent basic farmland, and urban development boundary, optimize and adjust the industrial distribution and urban development pattern in the river basin, and rationally plan the scale and intensity of urban development. Third, strengthen the management of water demand, impose the strictest control over water resources, encourage the recycling of reclaimed water, and improve the conservation and intensive recycling of water resources.

4.2 Strengthen environmental governance and ecological restoration

First, improve the urban and rural sewage treatment system. Accelerate the construction of domestic sewage collection and treatment systems, upgrade the existing sewage treatment plants, and further improve the sewage treatment standard to reduce the environmental impact. Improve the urban drainage system, build rainwater and sewage networks in new urban areas, and accelerate the construction of separate rainwater and sewage systems in the old district. Second, strengthen the control of agricultural non-point source pollution. Develop small-scale sewage treatment facilities in rural areas according to local conditions and establish a long-term operation mechanism for the treatment of rural household waste and sewage. Reinforce the reduction of pesticides and fertilizers, and the management of pollution from livestock and poultry manure. Third, promote water ecosystem protection and restoration, implement the environmental protection of important rivers, lakes, and reservoirs to high standards, strengthen comprehensive protection and regulation for rivers and wetlands, and gradually restore wetland functions.

4.3 Establish a sound mechanism for dynamic monitoring and early warning

Strengthen the monitoring and management of the main pollution sources and control the pollution discharge of enterprises. Improve the construction of the environmental quality monitoring network for surface water, such as the main river basins and reservoirs, keep well informed about the dynamic changes of urban water environments, establish a reasonable water quality evaluation model, and propose systematic countermeasures through scientific analysis. Promote the establishment of a cooperative mechanism for responding to environmental emergencies across river basins, causing the exchange of information and joint response to environmental emergencies.

4.4 Improve policies, regulations, and the river basin management mechanism

First, continue to improve the policies and regulations on water environment protection and management, and promote more stringent management and protection systems. Intensify law enforcement, constantly improve the mechanisms behind administrative law enforcement and criminal justice, realize the links between legislation, and reform decisions to focus on water environmental governance and protection. Second, improve the management capacity of rivers and lakes, by establishing comprehensive law enforcement agencies across the whole river basin. Clarify the responsibilities of administrative agencies, water-related functional departments, and governments of river basins, establish a cross-basin coordinating mechanism with clear responsibilities, and comprehensively implement the river chief system. Third, establish a sound assessment mechanism. Build the target responsibility system with the improvement of the water quality as the core focus, highlight the assessment weight of the water environment in the green development and ecological civilization construction indicator systems, and improve the enthusiasm of local governments for environmental protection and governance.

4.5 Establish ecological compensation and marketization mechanisms

First, promote and improve the inter-regional ecological compensation mechanisms for river basins across provinces. Taking the ecological compensation pilot of Xin'an River Basin as a reference, further explore and innovate the cooperative options for ecological compensation. Establish a fund for the ecological compensation of river basins lead by the government and introduce social capital to ensure the sustainability of ecological compensation funds. Establish a positive incentive and reverse constraint mechanism to reward compliance, encourage improvement, and punish deterioration, and build a diversified and market-oriented ecological compensation model. Second, improve the market-oriented mechanism. For key river basins, it is necessary to make full use of market means, improve the price mechanisms for resources and the environment, and reasonably promote emissions trading across administrative regions. Encourage social capital to participate in the construction and operation of water protection infrastructure. Promote third-party governance and monitoring of environmental pollution and build an environmental control system with the government having a leading role, enterprises as the main body, and social organizations/the public as the participants.

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